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EMERGENT CHEST WALL RECONSTRUCTION FOR AN INCARCERATED PULMONARY HERNIA

Short title: Management of an Incarcerated Pulmonary Hernia

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A 21 year-old male presented after a motor vehicle collision at 45 mph in which he was the restrained driver. He was stable on arrival to the trauma center with a GCS of 15, complaining of chest and right leg pain. ABCs were intact in this obese male (BMI 42) with a well-defined seatbelt sign and tenderness over the anterior chest wall. He was neurologically intact and pulses were palpable in all four extremities. Chest and pelvis x-rays were obtained which demonstrated atelectasis plus volume loss of the right hemithorax and a right acetabular wall fracture, respectively. [FIGURE 1a] CT imaging demonstrated bilateral sternoclavicular joint dislocations, right 1-3 costochondral joint disruptions, an anterior mediastinal hematoma with fractures of right ribs 2-8 and left ribs 2-4 without pneumothorax. The patient was intubated and sedated in the trauma bay for femoral traction pin placement to reduce his pelvic fracture. He was admitted to the trauma ICU for further management. Approximately 18 hours later, the patient was noted to have subcutaneous emphysema and an increasing pleural effusion [FIGURE 1B] prompting placement of a right chest tube with 200mL bloody fluid return. There was no ongoing air leak. Repeat chest x-ray demonstrated a large air collection extending from the right chest onto the neck and left chest. [FIGURE 1C] A repeat CT chest demonstrated herniation of the right lung through the right chest wall between the upper ribs, in the region of the sternoclavicular dislocation. [FIGURE 2] At the time of this CT, the patient was hemodynamically stable with a GCS of 11T. He was mechanically ventilated with settings including a PEEP of 12 and FiO₂ of 40%; saturating 100% with an arterial pO₂ of 104 and a mean airway pressure of 19.

What Would You Do?

- A. Median sternotomy with lobectomy and open reduction internal fixation (ORIF) of sternoclavicular dislocation
- B. Video-assisted thorascopic surgery with hernia reduction and coverage of defect with biologic mesh
- C. Anterior thoracotomy with reduction of herniated lung and ORIF of sternoclavicular dislocation
- D. Observation with decreased ventilator settings (PEEP) to prevent further barotrauma.

What We Did And Why?

(C) Anterior thoracotomy with reduction of herniated lung and ORIF of sternoclavicular dislocation.

Given our concerns that the herniated lung could become compromised, he was taken for urgent reduction and chest wall reconstruction. The patient was taken to the operating room and underwent a bronchoscopy, which demonstrated compression of the right upper lobe bronchus. [FIGURE 3] The endotracheal tube was exchanged for a double lumen tube to attempt single lung ventilation. Given the patient's need for probable chest wall reconstruction, specifically ORIF of the right sternoclavicular joint and superior ribs, a direct anterior approach was chosen. The patient had minimal pulmonary reserve (secondary to injury and obesity) and was unable to tolerate prolonged single lung ventilation, thus a thorascopic approach was not selected. A transverse incision was made over the upper right chest and immediately the subcutaneous air pocket was encountered. The entire right upper and middle lobes were herniated outside the thoracic cavity with evidence of pulmonary congestion and edema secondary to its incarceration. Herniation occurred through a defect created by the fracture/costochondral dislocation of ribs 2

and 3 and sternoclavicular dislocation, with impalement of the comminuted 3rd rib into the lung parenchyma. The incarcerated, herniated lung was circumferentially freed and reduced back into normal intrathoracic position without torsion. Upon reduction, the segment appeared to aerate well and had minimal air leak. A 32 French chest tube was positioned posteriorly at the apex under direct visualization. We then turned our attention to reconstruction of the 4 by 2 cm chest wall defect. For the sternoclavicular dislocation, bone tunnels were drilled in the clavicular head and manubrium to permit passage of a #2 Fiberwire suture in figure-of-eight fashion. Care was taken to avoid entrapment of the innominate vein during reduction of the joint. To close the anterior thoracic defect, fixation of rib 3 was indicated. A T-shaped plate was used to reduce and span the damaged costochondral segment from the sternum. [FIGURE 4] Sternoclavicular and rib 3 fixation adequately closed the hernia defect, which was bolstered by approximating the remaining intercostal tissue with absorbable suture. The subcutaneous tissue was closed in layers. The remaining rib fractures were non-displaced, thus they were managed non-operatively. The patient was transferred back to the ICU in stable condition. He underwent tracheostomy on hospital day 11, tolerated T-piece on day 14 and was transferred to acute rehabilitation on hospital day 18.

Figure 1: Chest x-ray upon arrival to trauma center. (A) Repeat imaging demonstrated a right-sided effusion and subcutaneous emphysema prompting chest tube placement. (B) Post chest tube placement with resolution of effusion and persistence of a large subcutaneous air pocket overlying the sternum, left upper chest and neck.

Figure 2: Axial and sagittal CT images demonstrating herniation of the right middle and upper lobes into the subcutaneous tissue with associated subcutaneous air pocket.

Figure 3: Bronchoscopy with compression of the right upper lobe bronchus (arrowhead)

Figure 4: Herniated right upper lobe visible in the subcutaneous tissue. (left) Completed chest wall reconstruction (right) with T-shaped plate on rib 3 and suture reduction of the right sternoclavicular joint (arrowhead)

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Figure 1

Figure 2

Figure 3

Figure 4